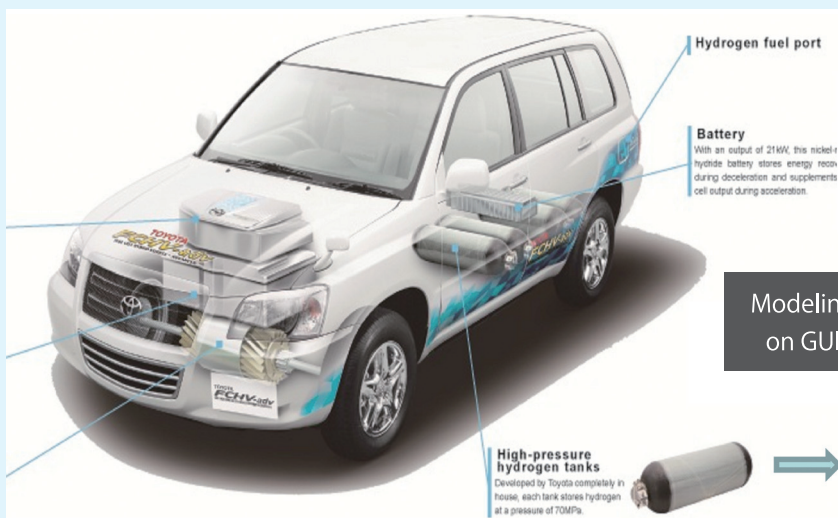# FRP Strength Reliability Analysis by
FrontCOMP

FrontCOMP_mold
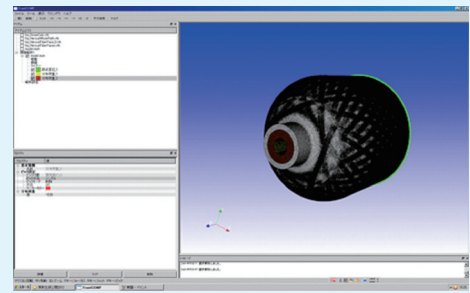FrontCOMP_cure
FrontCOMP_damage

Simulation system for advanced use of carbon fiber reinforced plastic (CFRP) with precise strength estimation!

Strength estimation of FRP pressure vessel for lightweight fuel cell vehicles

Hydrogen fuel port

Battery
With an output of 21kW, this nickel-hydride battery stores energy recovered during deceleration and supplements cell output during acceleration.

High-pressure hydrogen tanks
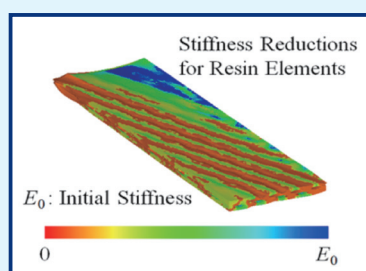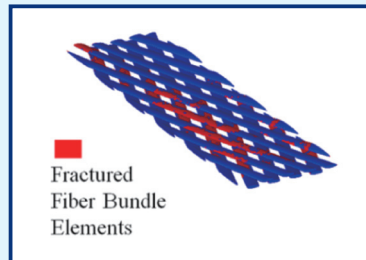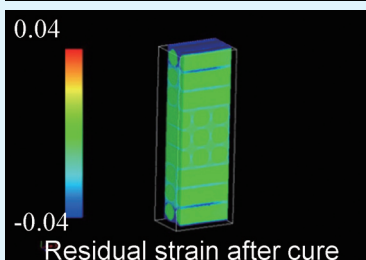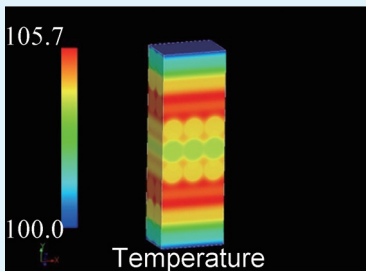Developed by Toyota completely in house, each tank stores hydrogen at a pressure of 70MPa.

Molding process simulator
(FrontCOMP_mold)

Modeling on GUI

Cure process simulator
(FrontCOMP_cure)

Damage propagation simulator
(FrontCOMP_damage)

105.7

100.0

Temperature

0.04

-0.04

Residual strain after cure

Fractured Fiber Bundle Elements

Stiffness Reductions for Resin Elements

E_0: Initial Stiffness

0   E_0
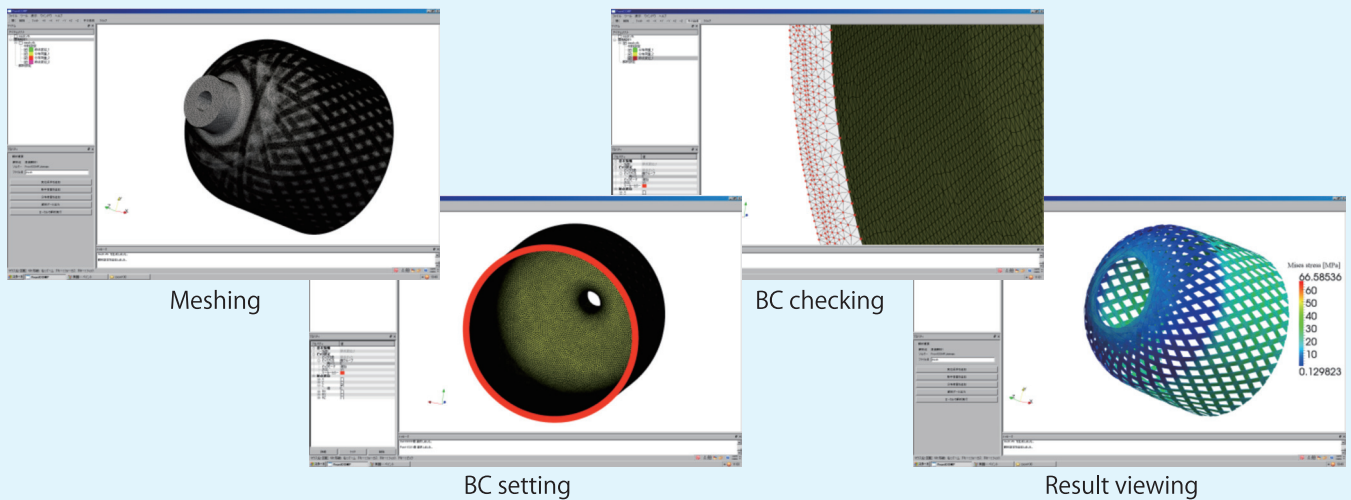
Initial defects arising in cure process are estimated for optimum temperature control.

Legitimate damage models for carbon fiber and resin are obtained independently by simple material models.

FrontCOMP system characteristics

Molding process simulator (FrontCOMP_mold)

- Fiber bundle path of filament winding
- Three-dimensional fiber bundle structure
- Mesoscopic model discerning fiber bundle and resin

Cure process simulator (FrontCOMP_cure)

- Temperature analysis with heat generation by curing
- Strain by heat expansion and resin phase transition
- Stress relaxation by visco-elastic analysis

Material models

Manufacturing knowledge

Damage propagation simulator (FrontCOMP_damage)

- Simple damage rules for resin and fiber bundle through elementary material tests
- Damage propagation in terms of decreasing stiffenss
- Direct handling of defects in resin
- Meso-mechanics from initiation to final fracture

Pre/Post processing on GUI

Meshing

BC setting

BC checking

Result viewing

- Analysis and boundary condition settings for pre-processing and outputting BMP, output files for AVS, and FEMAP for post-processing are now available.

Platforms

■ FrontCOMP_mold

OS: Windows XP x64
Compiler: Visual C++ 2008 SP1
Library, third-party software: VTK 5.4.2, ParaView 3.6, ADVENTURE TetMesh, (OpenCASCADE6.3.1)

■ FrontCOMP_cure and FrontCOMP_damage

OS: Linux (32 bit, 64 bit)
C compiler: Intel C
Fortran compiler: Intel Fortran
Supercomputers: HA8000 (The Univ. of Tokyo)
Note: Available on 1 CPU w/o MPI